Journal of the Society of Arts.

FRIDAY, FEBRUARY 23, 1855.

PURCHASE OF THE BERNAL COLLECTION.

TO THE HONOURABLE THE COMMONS OF THE UNITED KINGDOM OF GREAT BRITAIN AND IRELAND, IN PARLIAMENT ASSEMBLED.

The humble Petition of the Council of the "Society for the Encouragement of Arts, Manufactures, and Commerce,"

Sheweth,

1st.—That your Petitioners desire to call the attention of your Honourable House to a collection of Works of Art, extending from the Byzantine period to that of Louis Seize, which consists of upwards of 4000 specimens of Oriental, Dresden, Sevres, German, and Capo di Monte Porcelain; of Historical Portraits and Miniatures; of Mediæval Metal Work and Ecclesiastical Plate; Jewellery; of Limoges, Dresden and Oriental Enamels; of Carvings in Ivory, of Faenza and Palissy Ware; of Armour, Arms, and Stained Glass; Venctian and German Glass and Gris de Flandres; of Watches and Clocks, and of Ancient Furniture. These numerous objects have been collected by the late Mr. Ralph Bernal, member of your Honourable House and Chairman of its Committees for a long period, and are advertised to be sold by public auction on the 5th of March. Full details of the collection may be ascertained in a catalogue published by Messrs. Christie and Manson.

2nd.—That the said collection has been made by Mr. Bernal with sound judgment and great knowledge rarely found, and would be a most valuable acquisition for the Nation, calculated to improve public taste, and advance the arts and manufactures of the country.

3rd.—That such a collection being secured for the use of the country, would supply many of those deficiencies in the National Collections which place its Museums far below those of other European Nations, and might be made particularly useful at the Provincial Seats of Manufacture.

4th.—That in many branches the said collection is superior even to the collections of the Louvre, of Dresden, Berlin, and Vienna, and other European Museums.

5th.—That, besides its educational and manufacturing importance, the purchase of the collection would be a good commercial investment, as the value of such articles is daily increasing, and is worthy of being entertained even in the present time of war, when it is sound policy not to neglect the arts of peace, as is proved by the present commercial advantages which France enjoys in the production of articles of taste,—advantages which may be ascribed, in part, to the care which France bestowed on the general artistic education of its people, without intermission, during its course of wars and revolutions.

6th.—That the purchase of the said collection is well worthy the attention of your Honourable House, and might be secured, as your Petitioners believe, for about fifty thousand pounds, a sum which would not amount to a halfpenny on every hundred pounds sterling worth of manufactures produced for export and home consumption in the year 1854.

7th.—That, looking to the frequent mistakes hitherto made by past Governments, in declining the purchase of whole collections of Works of Art, and afterwards buying the remainders of them at greater cost than the whole, your Petitioners urge on your Honourable House that it would be the most prudent course to purchase at once the whole of the said collection, especially as duplicate specimens might hereafter be allotted among the different local Museums of the country.

Your Petitioners, therefore, pray your Honourable House to vote the necessary funds to secure to the Nation the benefits of the Bernal Collection.

And your Petitioners will ever pray.

Signed and Sealed with the Corporate Seal of the Society, by order of the Council,

P. LE NEVE FOSTER,
Secretary.

INSTITUTE BOOK ORDERS.

January Account.

	Full Price. £ s. d.	Red. Price. £ s. d.
Cambridge, Philo-Union Society	7 13 6	5 15 6
East Retford, Literary and Scientific Institution	0 19 8	0 16 0
Hants and Wilts, Educational Association	7 18 0	6 0 11
Hereford, Permanent Library	6 6 0	4 18 11
Horncastle, Mechanics' Institution	0 12 0	0 9 8
Lancaster, Church of England Instruction Society	1 5 0	1 1 4
London, Bank of England Library and Literary Association	5 5 6	3 17 11
Odiham, Mechanics' Institution	1 15 6	1 8 1
Pembroke Dock, Mechanics' Institution	14 18 0	11 10 0
Sevenoaks, Literary Institution	4 0 8	3 3 0
Stamford, Institution	3 9 6	2 12 8
	£54 3 4	£41 14 0

Being a saving of £12 9s. 4d., or nearly 25 per cent.

FLAX AND ITS PRODUCTS IN IRELAND.

Contributed by Wm. Charley, Seymour-Hill, Belfast.
Letter XI.

By the time the flax plant has reached its full growth, a certain proportion of valuable inorganic substances have been extracted from the soil by its small but multitudinous fibrous roots, and, by the action of natural development, have become incorporated with its constitution. Of course flax in this respect is just like the other crops on the farm, though less severe than many; all derive their inorganic constituents from the soil, and hence follows the necessity of manure to replace the loss so caused. Professor Hodges has suggested the following compound for this purpose, as regards flax, which I have no doubt is theoretically correct; but I have no experience to relate as to the effects in practical hands. This manure is to be sown broadcast over the field, before the last harrowing previous to sowing the flax seed:—

For One Acre (Statute Measure).

		s.	d.
Muriate of potash, 30lbs.,	cost about	2	6
Chloride of sodium, 28lbs.,	,,	0	3
Burned gypsum, powdered, 34lbs.	,,	0	6
Bone dust, 54lbs.	,,	3	3
Sulphate of magnesia, 56 lbs.	,,	4	0
		10	6

The usual system, as already mentioned (Letter IX.) is not to sow two crops of flax on the same soil, without an interval between of from six to ten years, so that the land under the ordinary agricultural rotation, is regularly receiving from the different manures applied, a part of the lost nourishment yielded to the flax, and in the time just specified is again ready to support another similar crop without any special restorative applications to the soil.

This point is much dwelt upon by the intelligent flax producing community of the ancient Flanders; the Société Linière, of Brussels, in its printed recommendations, states "above all things the rotation of crops must be scrupulously observed; if seven or eight years be allowed to elapse, before again sowing flax in the same field it is certain that there will be a good crop; but the less the interval between the two crops, the less is the second to be calculated on either for quality or weight."

It has already been said that before sowing, the farmer must determine whether he wishes for a good crop of seed, or has a preference for superiority of fibre. When seed is the principal object, the crop is of course sown thinly; where fibre, on the contrary, as thickly as can with safety be allowed, for the purpose of drawing up long thin stems, and gaining thereby a fine quality of fibre. In detailing the treatment of the flax plant, after it has reached almost full growth, care must be taken to discriminate between these cases, as the *modus operandi* in each is very different.

In the former case the plant is allowed to attain full maturity before being pulled, and is generally treated on the Courtrai system, which is considered the best for preserving prime seed. In the latter position it is gathered before being quite ripe, but the exact period to do so requires some judgment; the common rule is to allow two-thirds of the stalk to become yellow, and not to allow time for the seed capsules to become more than slightly tinged with brown. The Société Linière, already quoted, pronounces the following opinion:—

"It has been proved that when the flax is pulled between the falling of the flower and the formation of the seed, the fibre is finer and more solid than at any other time, so that unless it is wished to sacrifice the quality of the flax to obtain seed, the former must not await the full maturity of the latter."

As the after treatment of the crop destined *principally for seed*, will be described under the head of the "Courtrai system," it is more convenient to trace out here the progress of the plant when intended *chiefly* for the production of valuable fibre. The time for pulling, as above described, being determined, the next point is to select a fine day, and to have the operation carefully performed. The long and short stems must be kept separate as much as possible, and the lower ends kept even; the handfuls should be neatly placed over each other, so as to remain distinct; these should next be handed to the "ripplers," who pass the tops of the plants through a machine called the ripple—a kind of large comb, with wooden frame and iron teeth.* The two ripplers sit opposite each other, with a large sheet below on the ground, and the bundles of flax, after the seed is taken off by the instrument, must be bound up in small sheaves, and carried off to the pool for watering. It it not judicious to ripple the flax severely; it is even better to leave some of the seed on than by overclose rippling to run the risk of splitting or bruising the delicate fibres about the head of the stem. The cost of rippling is considerable, but I believe for every £1 expended, on an average a return is realised of £2, particularly on a farmstead where many horses and cattle are regularly kept. The flax bolls contain much more nourishment than the linseed cake, from which the oil has, of course, been expressed, and they form a most valuable addition to the warm food prepared during winter for the animals just named. I believe they have also a highly beneficial effect in warding off internal disease, owing, no doubt, to the soothing and slightly purgative properties of the oil contained in the seed. The change made in the appearance of the animals receiving some of the bolls in their steamed food is very apparent after a few weeks' trial, and the smoothness and sleekness of their shining coats plainly demonstrate the propriety and importance of the system. Is it not truly surprising, with this fact before our eyes, that many agriculturists—indeed, I fear the majority—persist in the old-fashioned system of taking the flax to the watering place with its valuable freight of seed untouched, and plunge the sheaves under the water, with their full cargo of produce on board, losing thereby, in the most wanton manner, rich feeding materials, worth from £1 to £3 per statute acre!

Yet so it is. I am even told that some think the cost of rippling exceeds the benefit; but I am firmly convinced, and am quite positive, my estimate of *cent. per cent.* profit on the outlay of rippling is under the mark. Some argue that the oil of the seed cast into the water has a *beneficial* tendency in assisting fermentation, and that the yield of fibre is always better in this old-fashioned way than in any other where the seed is taken into consideration. I am not prepared to say, in reply to this objection, that the oil has an *evil* effect, because I think it has *no material influence one way or the other*; but I would beg to call attention to the statement of an intelligent member of the Belfast Literary Society, who, writing on this subject many years ago, says, "The bolls *spoil the water* in which the flax is steeped, and are very troublesome in the grassing and breaking." Now I will just place this opinion of a practical chemist opposite the counter one already alluded to. As to the second objection, I have only to say, *pull the flax when the fibre is in the best state* for your purpose, and still take off *the bolls*; which, I repeat, under ordinary circumstances, will amply repay the outlay.

In India the flax plant is cultivated almost entirely for its valuable seed; and quantities of splendid oil are annually shipped to England; besides this we import from the Continent about 600,000 quarters of flax seed, and 70,000 tons of linseed cake annually. Most assuredly, if I had the power of a dictator in this country, I would,

* "The best ripplers are made of ½-inch square rods of iron, placed with the angles of iron next to the ripplers, 3-16ths of an inch asunder at the bottom, ½ an inch at the top, and 18 inches long, to allow a sufficient spring, and save much breaking of flax. The points should begin to taper three inches from the top."—*Extract from Royal Flax Society's Report.*

from patriotic notions, order that flax seed should not be sacrificed thus; let it be saved as carefully as grain.

When the bolls are first taken off, they are rather soft and green to keep, and consequently care must be taken to dry them thoroughly; the best way, when the weather admits, is to do so either outside in sheets, or in airy lofts, over which they must be thinly spread; but for feeding purposes, if the weather be indifferent, they may be gently dried on the nearest corn kiln. The slow drying plan by weather is, however, much the best system, and leaves the rich juices of the seed more valuable and nourishing.

When sufficiently dry, the bolls destined for crushing must be thrashed and the seed separated from the husks; this is not necessary when they are to be used for feeding only; the chaff is then a very useful auxiliary, and contributes a good deal to the efficiency of the bolls.

The flax seed having been taken off as completely as can be done without injury to the stems, the sheaves, neatly bound with rushes, should be carried to the bank of the watering place arranged for the purpose. This stage is one of the most particular, and decidedly the most disagreeable to be encountered in the management of flax. The effluvia during fermentation is so pungent and offensive as to attract notice even from the passing traveller. Mrs. S. C. Hall says, "in our progress through the north (of Ireland) we were always reminded of our proximity to a bogging (or watering) station, by the very offensive smell of the decaying flax." About Courtrai the flax is steeped in the river Lys, which contains a remarkably pure and suitable water. In Flanders district* (Paes de Waes) the flax is watered immediately after rippling, in the manner now generally recommended, and the water used is allowed to become partially stagnant in the pools previous to the immersion of the plant. In some parts of Ireland the flax is tied up in large bundles, which are attached to firm stakes by ropes, and plunged into the running stream in the same way as the Belgians do in the "Lys." This formerly occurred very frequently in the upper Ban river, County Antrim, but as the fisheries there are valuable, and the fermentation of flax is productive of noxious compounds, injurious to the health of fish, I question if it is now allowed.

It certainly is a strange fact, that the fermentation proceeds quite successfully in a *running stream* of fresh water; and it is evident, therefore, the process must go on in the juices and gummy matter, which connect the woody stem to the pure fibre of the plant, as the water itself has not time to become decomposed in passing through the bundles, a process that at first sight one would think necessary. The usual custom is to have what in old times were styled "lint holes," cut near a river, about six to twelve feet broad, and three or four feet deep, the lengths various, the pool or series of pools being so arranged as to admit water from the stream at one end when required, which would be generally a few days before the flax is ready for immersion. The sheaves of flax should be carefully placed in the water in one layer, rather sloped; the top should be covered with rushes, straw, or tough sods, and some stones put on last, to keep all firmly under water. In Flanders much more care is usually taken than in Ireland, as the flax is generally higher priced and admits of increased expenditure in its preparation. The Belgians have their pools very clean, and the cover used on the top of the flax underneath the stems is not unrarely made of basket or wicker work, so that the colour may not be tainted by contact with soil.

The period necessary to complete the steeping process varies considerably, according to the state of the weather; from 10 to 14 days is generally enough. Nothing, however, except practical experience, can prevent mistakes in this operation; it may be said, as a general rule, that when on breaking the stem of the plant the fibre separates freely from the woody part, that fermentation has done its duty, and the flax should be taken out at once.

The common way of performing this operation is to run off the water from the steep-holes into the stream, and afterwards take out the flax. Against this slovenly system I must record a serious protest, it being contrary to all correct acknowledged principles of agricultural economy.

In the first place, the "flax water" so lost is excellent liquid manure, and its effects can be clearly traced on meadow land, where the plant has been spread for "grassing" immediately after removal from the pool. This liquid ought, therefore, to be preserved and carted in large barrels over the grass fields adjoining, or thrown over by means of hose and pumps, on Mr. Mechi's plan. In the next place, by running off the water, all the scum and dirt in the pool are allowed to settle among the flax plants, and the bundles are pressed against the sides and bottom of the hole, where they are sure to become soiled and dirtied, thus injuring the colour and quality of the fibre. Lastly, the noxious fluid passing into the stream at a time when the river is at the lowest summer level, not only corrupts the water and renders it unfit for domestic use, but poisons the poor fish therein, an offence punishable by law.

Frequently have I seen the mountain streams in this neighbourhood, tributaries of the Lagan river, so polluted by this thoughtless mode of acting as to remind one very forcibly of the first great plague inflicted on Egypt—"And the fish that was in the river died, and the river stank, and the Egyptians could not drink of the water."

The offensive appearance and odour of this noxious liquid in our rivers can be so easily avoided, that the law prohibiting the nuisance ought to be strictly enforced, which at present is not done. The only proper way of taking out the flax is to make the men stand in the water, for thus the bundles are washed and cleansed in lifting out, and the liquid can be kept in the pools till spread over the meadows; or, if it must be wasted, it can be run off into the stream during the first flood or fresh, at which time its presence would scarcely be felt or remarked.

Before leaving this branch of the subject, I wish to call attention to Sir R. Kane's opinion as to the value of flax steep-water. This eminent chemist gives the following analysis :—

	Flax Steep Extract.	Ditto without ashes.
Carbon	30.69	52·93
Hydrogen	4·24	7·31
Nitrogen	2·24	3·86
Oxygen	20·82	35·90
Ashes	42·01	...
	100·00	100·00

There are found 42 parts of ashes in every 100 parts of flax steep extract, consisting of—

Chloride of potassium	3·8
Sulphate of potash	4·4
Carbonate of ditto	3·8
Carbonate of soda	13·2
Silica	5·5
Phosphate of iron and albumen	3·2
Phosphate of lime	2·1
Carbonate of ditto	4·0
Carbonate of magnesia	2·0
Per cent.	42·0

He infers, "that as the steep-water dissolves out a great quantity of nitrogen and other inorganic materials of the stem; it removes from the plant almost everything the plant removes from the soil,"—consequently there can be no better manure, or more speedy restorative for exhausted flax ground than this very steep-water, and it is universally admitted by the most intelligent writers on agricultural subjects (such as Wakefield, Billingsby, Hodges, &c.) that it is also a valuable manure for grass and pasture land, well worth the trouble and expense of application.

* See Sir J. E. Tennent's work on Belgium, Vol. II., published in 1841.

I hope the time is not far distant when this truth will be more appreciated and acted upon. I may here remark, that pure *soft* water is the best for flax steeping, and that all waters having strong mineral qualities should be avoided.

Professor Hodges mentions ferruginous waters as particularly bad, and states that "the action of the salts of iron upon the modification of tannic acid in the flax straw is very prejudicial."

Some recommend that the steeping pools should not be shaded by trees, especially those possessing astringent properties in the leaves and bark, as these may be blown off, and, falling down, may stain the flax. The uncertain and unequal shade of the foliage is another drawback, consequent on the too immediate vicinity of these natural and graceful ornaments of our river banks.

It is a great advantage to have the pools cut in stiff clay, as such soil is not only more retentive, but is much cleaner than any other.

Bog water is generally not very favourable for the fermenting process, though frequently used; indeed, in some districts the watering or steeping operation is styled *bogging*.

Mrs. S. C. Hall favours us with an amusing conversation on this subject, in her work on Ireland, Vol. III. I must confess, however, the dialogue is not in true northern style, but evidently smacks of the racy south. "And why do you bog it, Larry, we inquired once of an old fellow who was reported to have 'a mightly lucky hand entirely about flax.' Is it why we bog it, dear? Why then you see we must all pass through the waters of tribulation to be purified, and so must the flax—the bad you see and the good, in that small plant, is glued together, and the water melts the glue, so that they divide, and that's the sense of it, dear."

It is desirable to allow the bundles of flax a short time to drain on the bank after being taken out, after which hey must be removed to the spread field. This of course should be nice meadow or grass land, mown close, so that the spreading may be done evenly and thinly, and thus permit the flax to derive the full benefit of the sun and air. A situation sheltered from storms is preferable to high ground, as the wind is apt to toss the flax about, and increase the difficulty of handling.

A necessary point to observe is to turn the flax over carefully after undergoing a few days' exposure, so that both sides may be bleached alike; this can be done effectively with a long slight rod, great care being used to avoid tossing.

About the same length of time is required on the grass as is occupied in the steeping process, namely, from 6 to 14 days; flax that is *under* watered will need a little *over* grassing to assist in correcting the deficiency, otherwise the period must be regulated by the state of the weather.

When the flax appears dry and brittle in the woody part of the stem, a handful or two can be tested by the scutcher, and, if approved of by him, it should at once be lifted very carefully, keeping the fibres as even and straight as possible; it should be tied up in a neat bundle, and either removed direct to the scutch-mill, or stacked, like grain, in some dry and open position. All artificial means of drying should be avoided, as the natural air is the only safe system, and as the grassing takes place about harvest time, good weather may generally be reckoned on.

Before closing this letter I wish to describe the "Courtrai system, already alluded to as the best when the saving of seed is the primary object of the agriculturist. Many, however, assert, that by this plan the fibre is *not deteriorated*, and certainly in the district which gives this system its name, the quality of the fibre is excellent. In this country the system is, perhaps, scarcely so successful as to fibre. When this mode of saving the crop is to be adopted, the flax after being pulled is at once tied up in bundles without rippling; these are piled up in long narrow "stooks," thinly put together, so as to obtain the full benefit of the sun and air. When dry, probably after a week's exposure or so, they may be collected into larger bundles or sheaves, and put up into ricks in the field or in an open stackyard. During winter the seed is to be carefully taken off, and, under this mode of treatment, it is highly suitable for reproduction, or, if preferred, for sale to the oil manufacturers. Owing to the present state of our relations with Russia the supply of Riga seed ought certainly not to be depended on; it would, therefore, be not only politic, but, I think, quite remunerative, to rely more on our own resources, and to produce as much flax seed *at home* as would sow our fields and feed our cattle, independent of any such foreign supply. After the seed is taken off, the flax must be re-stacked or kept under cover till spring, when it can be watered, grassed, &c., in the same way as that saved in the common method, or it may be sold to some of the proprietors of the patent retteries, where the process of watering is performed on more rapid and systematic principles. The most prominent of these patents will require special consideration hereafter; meantime, in conclusion, I may state, that besides these many ways of treating flax after pulling, there is another system quite different, but now almost extinct in this country, namely, *dew rotting*. In some parts of Germany this mode of reduction is, I believe, still tried occasionally with coarse flax. The principle of the system is to omit direct *fermentation* in water, and to put the flax straight to the *grassing* process. The want of "the steeping" is, however, a *vital defect*, not easily remedied even by excessive exposure to the scorching rays of the mid-day sun, or the mellowing influence of the morning dew.

AN EXAMINATION OF MR. ALFRED SMEE'S PAPER "ON THE SUBSTITUTION OF SURFACE PRINTING, FOR COPPERPLATE, IN THE PRODUCTION OF BANK NOTES." BY THOMAS GRUBB, M.R.I.A., &c.*

It has for some time past been pretty generally understood that the Bank of England note, which for many years had resisted all visible change, was soon to undergo some important alterations and improvements. The nature of these has just been very fully communicated to the public, by the paper of Mr. Smee, read before the Society of Arts, on the 20th of December last, and published in their Journal for that month.

As the subject is in some measure one of general interest, and as the first published account of the new Bank of England note comes to us through the medium of a scientific society, I am led to conclude that those observations, which I feel at once desirous and to be of some importance to make on the subject generally, and also on Mr. Smee's peculiar views and conclusions, will not inaptly find a medium of publicity while being communicated to the present sectional meeting of the Royal Dublin Society.

In attempting an analysis of Mr. Smee's paper, a difficulty appears at first sight, arising out of its great length. It occupies upwards of 14 closely-printed columns. Four of these, however, are devoted to that art in the improvement of which Mr. Smee has long since distinguished himself, viz., electrotype; which process he puts into requisition for obtaining the fac-simile blocks used in preparing the form of the new Bank of England note. When I recollect those splendid specimens of electrotyped plates of the Ordnance Survey of Ireland, exhibited some years back in this room, (one of which would probably cover 100 of the tiny blocks used in the forms of the new note,) I feel there is no occasion to follow Mr. Smee through this portion of his paper.

Of its remaining ten columns much is occupied either by what may be termed the history of the subject, and of

* This paper was read at a late meeting of the Royal Dublin Society, and relates to the paper by Mr. Smee, read before the Society of Arts on the 20th of December, 1854, and published in No. 109 of this Journal, Vol. III., page 81.

Mr. Smee's proposed changes, or in minutely describing the manufacture of the new Bank-note paper, and the various manipulations and examinations which take place before it reaches the Bank, together with the sundry events which subsequently happen to it.

Perhaps I may be allowed, *en passant*, for the information of those who are not likely to read Mr. Smee's paper, to give a few particulars taken from this part of his description.

I shall premise that the note-paper, after an adequate amount of reckonings, transfers, &c., is at length printed; it thus becomes, as Mr. Smee describes it, a "perfect note." It is, however, still inanimate; it is yet to be born —not, however, as some might imagine, by being issued to the public, or even undergoing a change in its quiet position.

The event Mr. Smee describes as follows:—"These perfect notes are deposited in a place of security till life is given to them by being carried as a credit into the bank-books."

Mr. Smee thus continues his description:—"When it (that is the note) passes into the hands of the public, it is amenable to laws which are known to the authorities at the Bank. Each different denomination has a different average duration of life, like individuals in different cities, and some are never heard of again, like people who go to foreign lands and their fate ever remains unknown."

Should there be a difficulty with any one in understanding this poetical description, I may say that I believe it to mean simply—That different values of notes remain in circulation different lengths of time on the average.

The death of the note has an evident coincidence with its birth; it is thus feelingly described by Mr. Smee:— "When the note returns to the Bank, after inspection, it dies, never to be resuscitated."

Though the note thus suffers a very gentle death, it subsequently undergoes sundry post mortem amputations, which evidently render it quite unfitted for a second existence through fraudulent re-issue of any of the Bank officials. The registry of its death being taken by a system devised by Mr. Smee's brother, and in which we are told, "Those who are partial to the details of scientific book-keeping will discover many devices of interest."

I shall close my remarks on this fractional portion of Mr. Smee's paper with two observations. The first is— that I trust no one will infer either from Mr. Smee's paper or my abstracts, that arrangements equally effective with those rather ostentatiously described by Mr. Smee, have not, from the beginning, been adopted by other banks. My second observation here is, that while the details given by Mr. Smee of the management of the note paper and the printing, cancelling, &c., of the same, are such as any bank who print their own notes will wisely adopt for their own security, I cannot comprehend how Mr. Smee arrives at the conclusion announced by him in the same section of his paper, and in the following words:—"If we examine the note through its different stages we cannot help being struck with astonishment at the care which has been taken to protect the public from imposition." Nevertheless, and until I can find where the care for the protection of the public is provided for, in or by the sundry manipulations he describes, I trust he will excuse me, as also all others equally obtuse, from being in any degree astonished.

In proceeding with the more serious consideration of Mr. Smee's paper, it will be convenient to divide the subject into two parts, and consider firstly the adoption of the new water-mark paper, which, although no part of Mr Smee's suggestion, is advocated by him as giving additional security, and secondly, to consider the adoption of surface or block printing, in lieu of copperplate, being apparently the suggestion of Mr. Smee for the printing of the new Bank of England note.

But for a reason, which shall appear by and by, I would at once admit that the new or shaded water-mark affords a small additional protection, mainly however to the bank, as enabling them to discriminate a forgery when other sources fail. To make it available to any party, each note in examination must be held separately up to the light, and I believe that the public will agree with me in concluding that they would be at once more conveniently and more efficiently protected by something suitable printed on the paper, which could be examined by being looked at, rather than something in the paper which can only be examined by looking through it.

To illustrate the peculiarity of this new water-mark, I exhibit a sheet of paper which came into my hands in 1851. It shows a combination of light and shade, similar to that in the paper now being used for the Bank of England note. A patent appears to have been obtained for this new water-mark; what the date of the same may be I do not know, but I would here observe, that the sheet of paper now before you contains not only some manuscript of the late Mr. Thomas Oldham, dated 20th April, 1851, but also the water-marks include the names of Thomas Oldham, as inventor, and Thos. H. Saunders, fecit.

The manner in which the moulds which produce such shaded water-marks are formed is interesting, and I give it in Mr. Smee's own words:—"The essential part of this process is the use of steel-faced dies, which are engraved with the desired pattern, after which they are hardened by being heated in leather charcoal, and then suddenly plunged in water. These dies are used with copper or tin forces in a stamping machine, to give an impression upon plates of sheet brass, and these plates, when embossed, are filed on the back to the requisite proportions to allow the moisture of the pulp to pass through the apertures. The different pieces of brass, when struck, filed, and put together at the paper-mill by Mr. Brewer, form the mould for the paper, and are so arranged that each mould is designed for two pair of notes."

Mr. Smee then claims, as great advantages attending the use of the paper made from such moulds, "identity in the water-mark," besides being "specially adapted to give gradations of tints, lights, and shades," and next proceeds to eulogise the advantages which the mould-maker has derived from this new method of making his moulds. I again quote from Mr. Smee's paper—"If we contrast this simple and elegant method of mould-making with that previously adopted, the difference is sufficiently striking. In a pair of five-pound notes, prepared by the old process, there are eight curved borders, 32 figures, 168 large waves, and 240 letters, which have all to be separately secured by the finest wire to the wave surface. There are 1056 wires, 67,584 twists, and the same repetition where the stout wires are introduced to support the under surface. Therefore, with the backing, laying large waves, figures, letters, and borders, before a pair of moulds are completed there are some hundreds of thousands of stitches, most of which are avoided by the new patent. Moreover, by this multitudinous stitching and sewing the parts were never placed precisely in the same place, and the water-mark was consequently never identical."

Now I have a very strong opinion that this new method of making moulds, &c., is likely to produce a result exactly contrary to that which Mr. Smee anticipates.

Mr. Smee appears to forget that that which gives additional facility to produce the legal mould also gives the same facility to produce the illegal. A patent here is of no avail, while the process is highly favourable to the forger. There is no necessity that he should use steel-faced dies, brass or even hard wood will be adequate to his purpose; neither will he have to use pieces of brass for the shaded portions. I find, from direct experiment, that he has only to strike the wire web of the mould with suitable boxwood stamps to produce the required corresponding shades in the paper. So far from any additional difficulty being thrown in the way of the forger, I expect he will consider the new mould, so far as shading is concerned, to be quite a boon in his way, and that he will rejoice in getting rid of a large portion of the multitude of

stitches of the old mould, quite as much as the paid legitimate maker.

Mr. Smee urges a claim to additional identity in the new water-mark paper. Now so far as the shaded parts are concerned, identity, if obtainable, cannot be appreciated, and is therefore useless: and, for the other parts, the undefined character of any water-mark as seen in the paper, is such that taken in connexion with the unavoidable unequal contraction of the paper in the manufacture, it renders nugatory any greater amount of accuracy in a paper mould than can be readily attained by the imitator.

I am thus led to the following conclusions with respect to the new method of making moulds with shaded portions, and letters and devices for the same, viz.:—

Firstly—That letters, and other such devices, being more readily prepared by the new process, it follows that the multiplying such on the surface of the paper mould will in future be of less hindrance to the forger than formerly.

Secondly—That shaded figures or designs are so readily formed in the web of the mould by pressure from wooden blocks that no trust should be placed in such devices.

Thirdly—That from henceforth we should trust less to the water-mark as a test of the genuineness of a note, and consequently it is of increased importance that some portion of the printing should afford an adequate protection against forgery.

I now proceed to grapple with the second division of the subject, viz., the consideration of the substituting surface printing for copperplate in the production of bank notes.

The advantages which Mr. Smee assumes as the result of such substitution are—

Firstly—Increased facility and rapidity of production.

Secondly—Increased economy in production.

Thirdly—Printing effected on dry instead of damp paper.

Fourthly—Identity of subject or matter printed.

I should here state that the advantages assumed by Mr. Smee for his system are not thus classed by him. They have been collected from a general perusal of his paper, and are collated as above for the convenience of reference in examination.

The three first of these heads include what may be termed resulting advantages, and will be seen to be of minor importance. The last, or fourth head, is Mr. Smee's foundation stone of improvement, and that on which he builds his recommendation for and defence of change.

Now, with respect to "identity," of the high importance of which I am fully aware, I am prepared to show by-and-by that Mr. Smee has based his recommendation for change upon a false assumption, and I assert, and am prepared to prove, that in accomplishing a change from copperplate to surface printing, for the production of the Bank of England note, he has only introduced one system possessing identity to the rejection of another possessing the same quality, and in as high a degree.

And, with respect to the remaining or less important advantage of Mr. Smee's assumed advantage for his system I shall shew, by a very few figures, derived chiefly from his own paper, of how small importance even abstractedly considered, these are, at least so far as the Bank of England note is concerned. The daily required quantity of notes Mr. Smee states to be 30,000. This has been done lately on the old system, and with the old machinery, say by — 8 presses and 24 attendants, or it could be done with improved presses, using the old system of printing and working seven hours daily, by six presses and twelve attendants; or, if printed from surface blocks, or on Mr. Smee's system, it would require two presses and twelve attendants. So far, therefore, as the printing is concerned, there is no greater necessary difference than that of six machines and twelve attendants, against two machines and eight attendants, which in such extensive operations is surely not of that magnitude which should stand in the way of adopting that system which in other respects can be shown to be the best.

To prove my assertion, that Mr. Smee has based his recommendation for change upon a false assumption, I shall begin by giving a very concise description of a process which, although neither the process itself, nor the name of the person who introduced its use at the Bank of England has been once alluded to by Mr. Smee, I cannot think it possible that he is ignorant of.

If we take a block of steel in the soft state, prepare at least one of its surfaces flat and smooth, and engrave a design on that surface, we can, by adopting certain precautions in the hardening process, make the block or die perfectly hard, and, at the same time, preserve the engraved surface from injury. If we next take a cylinder of soft steel, prepared with suitable turned bearings or axles at either end, and place it in a frame or carriage in which it can be made to revolve on its own bearings, and, placing both die and roller in a machine adapted to the purpose, roll the soft smooth cylinder to and fro over the hard engraved surface of the die, using adequate pressure, we shall obtain on the surface of the roller a highly perfect reverse, in relief, of the subject engraved on the die, and without any injury to the latter.

The roller being next hardened with similar care to that previously used with the die, it (the roller) supplies the means of engraving, using the same combination of rolling and pressure as before described, a large number of fac-similes of the subject engraven on the die plates or surfaces as may be desired.

This is, in short, in principle the same as the method which, many years ago, was applied to engraving the copper cylinders used in the finer descriptions of calico printing, and it is that process which was subsequently applied in America, and in England by Perkins, and at the Bank of Ireland, and subsequently at the Bank of England by Oldham, to engraving portions at least of the bank-note plates.

I have looked carefully over Mr. Smee's elaborate paper without finding any reference to this process, while the only mention I can discover in it of the manner in which the note plates of the Bank of England have been engraved is contained in the following sentence, in which the date referred to is that of Mr. Smee making his suggestions for a change, viz., 1851. The words are as follow:—"Heretofore the notes and cheques of the Bank of England had invariably been printed from copper and steel plates, in which the lines were engraved or cut into the metal."

By this description hand engraving must be understood, and there is nothing in it descriptive of machine engraving, which acts, not by cutting or removing matter, but by a combination of rolling and pressure.

It is now fourteen years since I became acquainted with this method of engraving, previous to which it had been in use for engraving the vignettes and some other parts of the note plates of the Bank of Ireland, and had been used by Oldham for engraving a portion of the Bank of England note plates. I soon saw that the method was capable of extension, and that, with improved machinery, all parts of the note plates, including the writing, could be by it engraved. This has been done as opportunity presented itself, and as a proof of the capabilities of the system to produce identity, I may instance the present form of one pound note of the Bank of Ireland, now in circulation for five years without a single forgery appearing. The same note-plates, refreshed from time to time, as required, by the same engraving rollers, retain their identity from year to year, dot for dot, line for line, each plate so identical with the rest of the series that but for the number of the plate, which is the only part engraved by hand, there would be no means for telling from which of the several plates in use any one individual note was printed; and so rapid and certain is the process that a subject can be either engraved, or when required refreshed, in probably as many minutes as it would require days by

the electrotype process to produce a corresponding block suited to surface printing.

Lastly, this is a process which, together with the person who introduced its use in the Bank of England note plate, and the son who succeeded him in its use, and who must have played an important part in the production of the shaded watermark, Mr. Smee has thought fit, for good reasons no doubt, to be totally oblivious respecting. In bringing the subject to a conclusion, I propose to make a few general remarks, which, it will be seen, chiefly apply to the economic production of bank-notes.

In a former part of my paper I have granted that, abstractedly speaking, Mr. Smee's plan of printing notes had an economic advantage. I now come to consider the question of economic production in a general manner, and here a principle of very extensive application presents itself, viz., that in the production or manufacture of a complex or compound article, if the desired degree of excellence can be arrived at by a modified excellence of the component parts, it is, in such case possible, that the economic production of the complex article may be much affected by a judicious tempering of the qualities, &c., of the several ingredients which form the whole.

The bank note is a striking illustration of this theorem; it is composed essentially of two ingredients, viz., the paper and the printing. The intrinsic excellence consists in the non-liability to fraudulent imitation, and the required amount of excellence may be derived either from the paper or printing, or in part from each of these.

By pushing our economic analysis a step further, we find a striking analogy to exist in one respect between these two ingredients, viz., that the mould in which the paper is formed, and the plate or surface used in printing, are not only the great sources from which we derive the desired respective amount of excellence, but they are also of merely nominal expense, for we can obtain from a quarter to half a million of sheets of paper from a pair of moulds, and a similar number of notes, using occasional repair, from one note plate.

The analogy, however, ceases here, for while every addition to the water mark brings with it a serious addition to the trouble and cost of manufacture of the paper, any addition, either to the quantity or quality of the matter on the engraved plate, scarcely affects the cost of printing.

Such general principles clearly indicate that for economic improvement it is to the printing and not to the paper of the note that our energies should be directed.

The Bank of England note, previous to Mr. Smee undertaking to improve it, had for many years remained a striking illustration of anti-economical principles. It had, however, the advantage of being printed by a system which left it open to improvement, and I think it quite within bounds to assume that had, at this time, a sum of £50 been judiciously expended in providing a suitable vignette or device, and combining that with the note, 50 times £50 might have been saved annually in the item of paper, and, at the same time, additional security against forgery given to the note. However, Mr. Smee has taken an opposite course, and, by adopting a completely different system for printing the note, he has effected two very important things, whether important for good or evil, time will tell. Firstly, he has rendered it more than ever necessary to retain the use of a highly expensive paper for the Bank of England note, and thus put a seal upon the possibility to its economic improvement, only to be broken by a fresh revolution in the machinery of the Bank and the system of printing the note.

Lastly, by the introduction of type or surface printing he has involved the necessity of using an ink which, so far as I can learn, is necessarily of a quality well adapted to be transferred and used, according to the lithographic process, for printing fac-similes of the genuine notes in lithograph; and when it is recollected that the impressions from type or surface printing are of a character very closely resembling lithographic impressions, it would appear that Mr. Smee's vaunted alterations are not yet to be classed as improvements.

Home Correspondence.

REVIEW OF MR. MUIR'S PAPER ON THE SMOKE NUISANCE.

By C. W. Williams.

Sir,—Mr. George Walker Muir having, at a meeting of the Society, read a paper "On the Smoke Nuisance, considered Morally, Historically, Scientifically, and Practically," it now remains on record in the Society's Journal for public use and comment. From so comprehensive a title it might naturally be inferred that the author was fully conversant with the subject—was acquainted with all recent improvements, and with the most advanced state of information in connexion with it.

Under this impression I examined Mr. Muir's paper with attention, the more so as I had myself, during the last twenty years, been engaged in considering the subject scientifically—by reference to the highest authorities; and, practically, on the largest scale in connexion with the land and marine boilers in the steam vessels under my direct control. Besides, that I had recently published a treatise on "The Combustion of Coal, Chemically, and Practically Considered," with the view of showing that the system hitherto adopted in our furnaces was essentially erroneous.

The smoke nuisance having engaged much of the public attention, and having become the subject of a recent parliamentary enactment, (16 and 17 Vic., Chap. 128,) had a legitimate claim on the Society of Arts as a medium for obtaining and disseminating useful information. Among those who consider themselves competent to instruct the public, through the Society, Mr. Muir presented himself, professing to examine the smoke nuisance, "Morally, Historically, Scientifically, and Practically." On the two first heads of his treatise I will here offer no remarks. To the two latter alone the following observations will be directed:—

Mr. Muir states, that "his enquiries have extended over a period of several years, and have been directed to the ascertaining the truth, rather than to the discovery of any hitherto unknown mode of smoke-burning or prevention." This direct reference, *in limine*, to what may be considered the prevailing impression, or rather error of the day, naturally led me to anticipate a scientific examination of the theory or doctrine of *smoke-burning*, in the pursuit of which so many patents have recently been obtained; together with the grounds, chemically considered, on which such an averment had been based.

Although Mr. Muir has professed to examine the subject scientifically, he appears, throughout, to have ignored its dependence on, or connexion with, that branch of science—chemistry, on which, however, the whole depends. Indeed, he actually sums up by saying, "once more I have to repeat that the smoke nuisance involves the consideration of *dimensions*, not inventions," meaning, the sizes and areas of the several parts of furnaces, flues, and chimneys. This is virtually assuming that the effective combustion of coal is within the department of *mechanics*, and not of *chemistry*. That the ignoring chemical considerations, and looking for a remedy for the nuisance to the *dimensions* of furnaces is a deliberately formed part of Mr. Muir's theory, may further be inferred from his opinion given in a recent letter to the Institution of Civil Engineers, to the effect that too much attention had been given to chemistry and chemical considerations, and that such only tended to render the subject more complicated. Now, I at once join issue with Mr. Muir, and assert that the smoke nuisance and its abatement involves mainly, if not exclusively, the consideration of chemical details, processes, and products. The reducing these to practice being that which necessarily belongs to all physical operations, namely, the character of the vessels in which such processes are to be carried on. In reviewing Mr. Muir's treatise, a few

words on the scientific branch of the inquiry must here, therefore, have precedence.

Effecting the combustion of fuel so as to avoid the creation of the smoke nuisance, involves the bringing together and effecting the chemical union of certain portions of the constituents of the fuel and atmospheric air. These constituents are—hydrogen and carbon from the fuel, and oxygen and nitrogen from the air. Now, if the bringing these together, ascertaining the due quantities of each that enter into union, examining their respective characteristics and affinities, and the mode of affecting that chemical union from which heat is involved, be not within the department of chemistry rather than mechanics, the very term, *chemistry*, may be at once expunged from our scientific nomenclature.

In examining Mr. Muir's paper, I find he has been carried away by the once common impression, that all coloured vapours, particularly those arising from the use of combustible bodies, were *smoke*. Such an impression was, no doubt, pardonable, during the last century, and when we knew no better. Before the nature of combustion or combustible bodies was understood, or the very term *gas* had any defined meaning in our language—our great lexicographer, even describing it as "a word invented by the chemists, and as seeming to signify a spirit not capable of being coagulated."

That so unsound, and, as we may now say, so absurd a doctrine respecting smoke should be seriously entertained in our day, would be as if we considered the labours of Dalton, Davy, and the other great luminaries of science, as but the reveries of the alchymists; and, as though we were thrown back on the age when air, earth, fire, and water, were taken as the sole elements of nature. Indeed, nothing can be more illustrative of the prevailing neglect of chemical science, or its practical application on the part of smoke-burning theorists, than the very existence of the controversy in question, namely, whether smoke be a combustible or an incombustible—in other words, what is smoke?

The theorists of the present day (among whom Mr. Muir appears to take a prominent part) assert, and, with the assumed aid of "scientific and practical" experience, that the coloured vapour, generated from coal, when subjected to heat in a furnace or retort, *is smoke*, and not *gas*, and that *gas is purified smoke*, as Mr. Muir asserts.

Another leader among the smoke-burning theorists, and who also addressed the Society on the occasion of Mr. Muir's paper being read, was Mr. Woodcock. In support of this theory, that gentleman ingeniously imagines two kinds of smoke, viz., *parliamentary* smoke and *true* smoke. In a recent letter in the *Mechanics' Magazine* he has thus described these two species of the genus smoke. "First, parliamentary smoke (or smoke as popularly understood), that is, what a furnace fire, covered with small coal, and smothering all flame, emits." This reference to *popular* impressions is rather an odd mode of deciding a chemical issue, and the more so as it should be the peculiar office of science to correct and remove popular errors, rather than to adopt and perpetuate them.

What Mr. Woodcock has here described is practically subjecting coal to a distillatory process, as in the retorts of the gas works. This inference, then, that what is generated from coal in the furnace is *smoke* and not *gas*, might be allowed to pass, were it not that even the most palpable errors, when once promulgated, are too often adopted by the mass of the community, who will not examine or think for themselves.

Mr. Woodcook continues—"There is also another substance, let us call it *true* smoke. Mr. Williams says [Mr. Woodcock in justice should have added, "in common with all writen authorities"] that this is the result of imperfect flame [imperfect combustion], and consists, for the most part, of steam, carbonic acid, and nitrogen, and minute portions of carbon in suspension. It is admitted that the two gases [and the steam] are incombustible." Now this mere enumeration of these incombustible elements of "true smoke," one might have thought sufficient to correct the errors of the most inveterate smoke-burners.

Another of the theorists who insists that smoke can be burned—in other words, that it is a combustible—is Mr. Charles Blashford Mansfield. In a letter inserted in the *Mechanics' Magazine*, and in support of Mr. Woodcock's views, Mr. Mansfield gives the following notable illustration of the grounds on which he forms his faith, in asserting that what all the world knows to be and calls gas, is not gas, but is—smoke. He observes:—"If any of your readers still believe that smoke cannot be burned, that is to say, for practical purposes, or consumed, he may satisfy himself by the following child's experiment. Let the bowl of a clay tobacco pipe be filled with coal powder, luted over with clay, and put into the fire in a common hearth. Let the nearest child or adult, of either sex, (how impartial an experimentor) be asked, "what the fumes are which will soon be seen issuing from the tube end of the pipe? He, she, or it, (or it!) will answer—*Smoke*. Let a lighted candle then be applied to it. I tried this experiment when I was an occupant of the nursery." Without meaning to be offensive, one is here tempted to ask whether such an opinion be not a sufficient qualification for an occupant of the nursery—at least of chemistry.

To bring this theory, however, to the test, I have, though in vain, inquired of these public instructors, if those vapours which issue from the pipe, or the fresh charge of fuel in the furnace, be smoke, *what then is gas?* Mr. Muir alone has had the courage to reply, manfully asserting that "Gas is purified Smoke." Now the question put is a purely scientific one, and admits of no personal feeling, and should not have been evaded by any writer professing to treat the subject scientifically.

On this I may here quote the observation of a competent witness, Mr. James Newlands, engineer to the Corporation of Liverpool, and who, in his last annual address as President of the Polytechnic Society, observes:—"The subject of smoke prevention has long occupied the attention of this society. So early as 1842, it was fully discussed. The looseness and inaccuracy of the expression 'Smoke Combustion,' has been properly animadverted on, and I wonder that it should ever be used by any one who knows the meaning of words, yet used it is, and has done an immensity of harm, having sent many on the search for that which is as visionary as the discovery of the perpetual motion." In his paper, Mr. Muir, I regret to find, although professing to have examined the subject scientifically, adheres to the error of mistaking gas for smoke, and then adopts the inference, that "smoke can be burned."

Mr. Muir, having given his essay so prominent a title and character, and having brought it before the society with so high a degree of pretension; having also introduced my name and treatise apparently for the purpose of contradicting the facts and statements there given, though shown to be in common with the highest chemical authorities of the day, I feel bound in justice to the Society and to the public, to make this review of his paper.

In considering this question, and its bearings on the Smoke Nuisance, it is manifest we should first understand what we are discussing—in a word, that we should know and determine *what smoke is*, before we can be in a position to say how it is produced, treated, consumed, or avoided. Again, that we should steer clear of the existing confusion in terms, and distinguish gas from smoke, otherwise, discussion would be a mere waste of words. For this purpose I will examine the several points insisted on by Mr. Muir.

1st. At page 138 of the Journal he observes, "As the burning of smoke is the consumption of the carburetted hydrogen gas evolved from the fuel, it follows that the product of that combustion will mainly be the same as that from the gas in our houses." Here is confusion worse

confounded, inasmuch as smoke, in the above passage, is taken as tantamount to carburetted hydrogen gas, —in other words, it means that the consumption of carburetted hydrogen *is* the combustion of carburetted hydrogen; for if, as he observes, the burning of smoke is the consumption of the gas, so, *vice versa*, the burning of the gas is the consumption of the smoke. This, however, is but trifling with the subject, while it has this disadvantage, that it is but leading the public and Mr. Muir himself away from the true merits of the question.

2nd. Mr. Muir observes, "I am sorry to differ with Mr. C. W. Williams when he says, it is impossible to consume smoke when once formed. *It can* be consumed. By that I mean that the *gas, vapour, or smoke, or whatever else it may be called*, which, whenever formed and permitted to pass through the flues and chimney into the air, the *constables* will call smoke." Here, then, the constable is to decide whether that which issues from the coal be gas, vapour, or smoke, Mr. Muir himself appearing undetermined, or unable, to say what it is.

Now, instead of taking the constable as an authority, had Mr. Muir referred to those writers who have so elaborately entered on the inquiry, and have given details which admit of no doubt or controversy, he would have found that "the gas, vapour, or smoke, or whatever else it may be called," had been thoroughly examined and described by the ablest chemists of the age, and admitted of no uncertainty whatever.

3rd. With reference to the assumed combustibility of smoke, an important point for consideration is here raised, viz., what is the quantity or weight of this finely divided, uncombined carbon, in any given volume of smoke?—for on this depends the question of economy in effecting its combustion. It would occupy too much space here to shew that, compared with the great volume of admitted incombustible gaseous matter escaping by the chimney, it is utterly insignificant, even if it were possible, which it is not, to separate and collect it. It will only be necessary to observe that whatever may be the amount of this carbon in the smoke, say from a ton weight of coals, it must go off, in company with, and intimately diffused through, the 400,000 or 500,000 cubic feet of those incombustible gaseous matters which form the products of combustion in the furnace. These products are as follows:—

1st. *Steam* (in enormous quantities), though, from the circumstances of its being invisible, remaining unnoticed by ordinary observers. This steam arises from the combustion of the hydrogen of the gas, and is equal in quantity to what would be produced by the vaporation of no less than half a ton of water, or say, half the weight of the coal used.

2nd. *Nitrogen* (also in large quantities,) being the incombustible part, or 80 per cent. of the air employed, after it has parted with its oxygen.

3rd. *Carbonic acid* (also in large quantities,) arising from the combustion, first, of the solid or coke portion of the coal on the bars; and secondly, of so much of the carbon of the gas as may have obtained contact with the air, and have entered into combustion.

4th. *Carbon*, in the purely divided state in which we see it collecting on the wick of a tallow candle. This, as to quantity, involves just so much of the carbon of the gas as had *not* obtained contact with atmospheric oxygen before its temperature had been reduced from its incandescent state, in flame—and, therefore, not entering into combustion—had returned to its state of black pulverulent matter as seen in soot or smoke.

Here we have all the elements of the coal and the air accounted for. Whatever then may be the colour or constituent of the smoke, it is manifest that we cannot dispense with the inconvenience and presence of the three first named products from the furnace, and their enormous volume—namely, steam, nitrogen, and carbonic acid, all of which are incombustible.

On this point Professor Brande's statement is conclusive. "The throwing jets of air into the inflammable gases and vapours which constitute so large a part of the matters which, in many ill-constructed fire-places and furnaces, escape by the chimney, with the *finely divided carbon or black smoke*, renders them available as sources of heat; and where that system is perfectly applied, the smoke can consist of very little else than carbonic acid, steam, and nitrogen—all incombustible, and also incapable of supporting combustion." Here we have text and context of what regards the elements and combustibility of smoke; the same illustrations being found in all chemical works of authority. Why, then, have not Mr. Muir and the smoke burning theorists sought for information in the proper quarter, and where no doubt can exist, and thus disembarrass both their own minds and the subject itself of the difficulties under which they labour, rather than relying on the mere sayings of ignorant firemen in the stoke room—of the "occupants of the nursery," or the metropolitan police?

4th. With reference to the quantity of carbon contained in smoke, Mr. Muir and the public are under great misapprehension when they speak of its being possible to consume it. Instead of being a mass of combustible matter, as the eye would lead us to believe, the amount that exists in any cubic foot of it, though comprising countless myriads of atoms, would not, *in weight*, be equal to that of a pin's head. Are we not justified then in calling for proof, either of the combustibility of the mass itself, or the economic value of such carbon, were it even separated and again employed as fuel? Yet, on the mere presence of this comparatively insignificant portion of combustible matter (but which ought not to be there) depends the theory that "*smoke can be burned;*" for, if the gas issuing from the fresh fuel in the furnace be properly supplied with air, (and as I have myself shewn to Mr. Muir,) there would be no more of this visible carbon in existence in the furnace or chimney than in the argand gas burner. With equal propriety, then, might it be said, that water was a combustible and could be burned, seeing that it contains hydrogen, or, that carbonic acid could be burned, seeing that it also contains carbon.

5th. Mr. Muir observes, "When we attempt to acquire a knowledge of the combustion of fuel and the prevention of smoke, we are bewildered by the variety of means advanced on various branches of the subject." Yet, how could it be otherwise, seeing, as already observed, that application for correct information on the subject has not been made in the right quarter. Let Mr. Muir be assured that there is but one way of avoiding the bewilderment of which he complains. Let him take up the work of any of those living authors who have treated on the combustion of fuel and the characteristics of coal gas. Let him study it until he is master of the subject, and he will then find that, instead of confusion, all is order, perspicuity, and certainty. Chemistry is an exact and positive science. It is, however, only to be learned, and practically applied, like other sciences—namely, by study and experiment.

6th. Mr. Muir observes, "We see it asserted by one authority, with a great array of chemical knowledge, that smoke is incombustible, and if once formed cannot be consumed." Does Mr. Muir mean the work of Mr. C. W. Williams, or the array of authors of unquestionable authority there referred to, viz., Brande, Faraday, Davy, Ure, Kane, Reed, Turner, and numerous others. Let him study them, or any of them, before he assumes the professor's chair, to teach the Society of Arts, or the public through them, as to what belongs to the generation or combustion of carburetted hydrogen and its constituents; to their union with the constituents of atmospheric air, and to their required temperatures, all of which are introduced into his paper, and treated as if no authority existed in reference to them. Let him thus qualify himself before he can be in a position to assert that "much learning has been thrown away on the subject," or satisfy the public that, in effecting the perfect combustion of combustible matter it is not the quantities, affinities, and

other processes to which they are to be subject, that demand our attention, but the "dimensions" of the vessels in which those processes are to be carried on.

7th. "Smoke," says Mr. Muir, "as it appears to the eye when issuing from a factory chimney, is a compound of soot, dust, steam, and gas, of the same description as is distributed and produced by the gas companies." According to this dictum, that which issues from the chimney, and what is distributed by the gas companies, are identical. Is this given as a sample of the amount of knowledge that justifies a man for discussing the subject "scientifically and practically." Is "the eye" to be the test on such chemical subjects, or on one of the most complex operations of nature, namely, the production of heat and light from combustible bodies? and are we to be gravely informed that what we burn in our apartments and purchase from the gas companies is "a compound of soot, dust, steam, and gas?" If this is to pass as the qualification test of a public scientific instructor on the combustion of coal and the cause of the smoke nuisance, it is manifest that the chemical schoolmaster, at least, is not yet abroad.

8th. Mr. Muir continues—"If the first, or sooty portion, be removed, the public will be satisfied." But who is to decide what that sooty portion is? what brought it there? and how it is to be removed? It is clear Mr. Muir himself has not made up his mind on any one of these points. "Cure me," says the patient to his doctor, "but never mind inquiring into the nature or cause of my complaint —that would only 'complicate' the matter." No doubt the public would be satisfied if the evil were removed. The question, however, here is, how is he who undertakes the remedy to proceed, until he first understands the cause and character of the evil? And does not this open the very question of chemistry?

9th. Again he adds—"The smoke which affects the public is mainly composed of hydrogen and such portions of carbon as are thrown off with it." Having already shown in detail what the smoke is composed of, and as laid down by the highest chemical authorities, it is here only necessary to add that Mr. Muir's statement is altogether erroneous.

10th. Mr. Muir goes on to speak of the "conditions of combustion;" of the "subjects of combustion;" "of the necessity for bringing them into contact;" "of the heat required for their ignition;" of the "results of imperfect combustion;" and instead of "an array of chemical knowledge," he gives an array of assertions, though on purely chemical processes, not only without reference to a single authority beyond that of the constable, but many of them in direct opposition to all known and reliable authorities. Nevertheless, we find him condemning the "array of chemical knowledge" on the part of others, although such knowledge was given as extracted from the works of the ablest chemists of our day.

11th. Mr. Muir states that "the two leading assertions of Mr. Williams are, 'smoke once formed cannot be burned in the same furnace; and that for its prevention, the air must be admitted in thin films or in thinner jets." On this he peremptorily asserts, "Smoke may be consumed, and its prevention is not affected by the admission of air above the fuel, whether in one volume or in many small ones," although he had just stated that "no doubt the more complete we can mix the air and the gases, the more completely will be the combustion." Does Mr. Muir not see that this very intimate mixing, and which he recommends, involves the whole question of effecting complete combustion? Indeed, I might here refer to the numerous patent *re-inventions* lately obtained for effecting combustion without smoke, the basis and principle of which is the effecting this very mixture with due rapidity, and causing the air to enter "in many small volumes," by the use of the perforated apparatus, in direct imitation of the mode pointed out in my treatise.

Having already occupied the limits assigned to me in your Journal, I am necessarily obliged to conclude, hoping, however, that I may be permitted to continue this review, seeing also that I have still many unsupported assertions of Mr. Muir to notice, as also to point out the direct connexion between perfect and imperfect combustion, and the existence of the smoke nuisance.

I am, yours, &c.
C. W. WILLIAMS.

Liverpool, February 12th, 1855.

THE DISCUSSION AS TO WATER SUPPLY.

SIR,—In reference to the discussion contained in your number of the 2nd instant, after the reading of the paper on "The Chalk Strata Considered as a Source for the Supply of Water to the Metropolis," wherein I partly described the gauge for ascertaining the annual depth of rain sinking into the ground, used by Mr. Dickenson at Apsley Mill, near Hemel Hempstead, Herts, I notice a letter in your last number of the 16th inst., from Mr. John Evans (Mr. Dickenson's partner), in which, among other things, Mr. Evans states "that no peat was mixed with the soil with which the gauge was filled, and through which the rain percolates," &c.

That your readers may be in a position to judge for themselves, between my statement respecting this gauge and that of Mr. Evans, I herewith enclose you a drawing, (see woodcut, page 245,) showing the sectional elevation of the gauge alluded to.

This drawing was made in 1852, for a Committee of the House of Commons, from memoranda in the possession of and under the direction of Mr. William Long Tyers, an intelligent mechanic, who was in Messrs. Dickenson's employment as foreman of Apsley Paper Mill, and as overlooker of machinery in Messrs. Dickenson's paper mills for 17 years, namely, from July 1832 to July 1849.

The gauge was constructed, filled, and fixed for Mr. Dickenson, in the year 1835, by Mr. Tyers himself, and Mr. Tyers, some years after the gauge was made, took an account of, and registered the amount of water passing through it.

By referring to the woodcut you will find that a stratum of peat, two inches thick, is placed between the soil and the top of the gravel that covers the chalk, as stated by me, and reported in your Journal of the 2nd instant, page 181.

In 1852, I had occasion to have the guage examined. At that time a sixpenny piece could be passed at the top between some of the joints of the wood of which the body of the gauge was made.

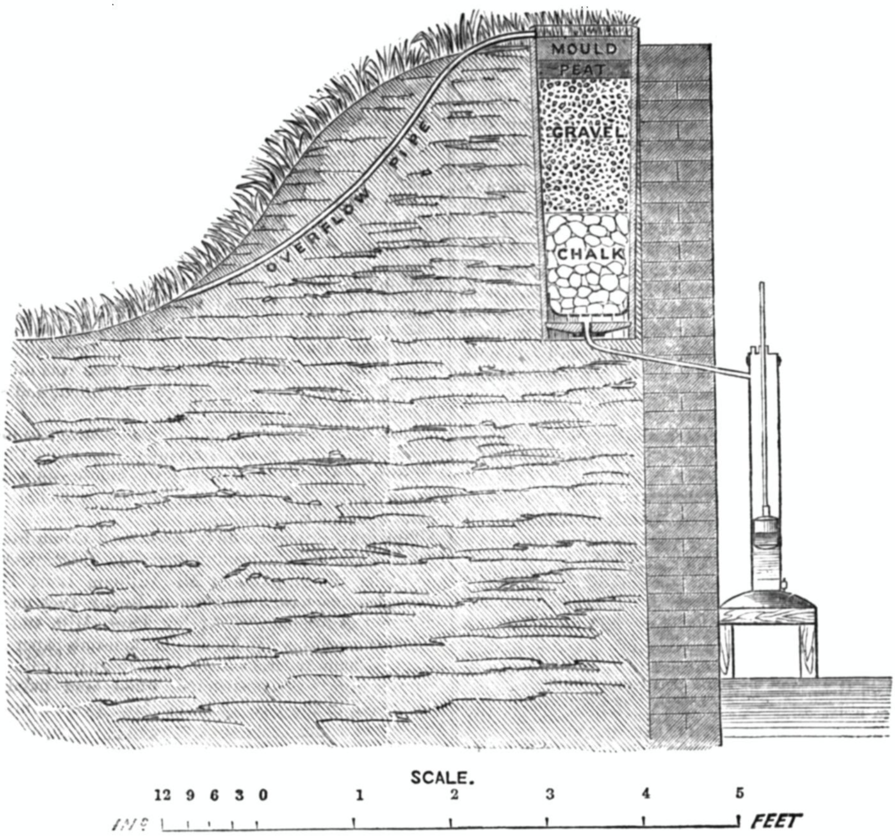
In Rees' Cyclopædia, article "Evaporation," the construction of a gauge by Mr. Hoyle and Dr. Dalton, of Manchester, of which Mr. Dickenson's is an imperfect imitation, will be found thus described:—

"They took a cylindrical vessel of tinned iron, ten inches diameter, and three feet deep; there were two pipes soldered into it, one at the bottom, the other at the top, for water to run into the bottles. The vessel was filled with gravel, sand, and soil, and subsequently the soil was covered with grass and other living vegetables. It was nearly buried in the ground in an open situation, and provision made for placing bottles to the two pipes; in this manner it was exposed to receive the rain, and to suffer evaporation from the surface, the same as the surrounding green ground. A regular register was kept of the water which percolated through the soil and gravel into the bottles, and a rain gauge of the same surface was kept close by, for the sake of comparison."

Thus Dr. Dalton made the body of his gauge of metal, and a bottle was placed to catch the water from the overflow pipe, as well as from the body of the gauge; while Mr. Dickenson made the body of his gauge of wood, and omitted to place a bottle to catch the water from the overflow pipe.

That no dependance can be placed upon the results given by such a gauge, even when well constructed and properly used, has long since been known. On this subject I would refer to a paper read by Mr. Bateman, C.E.,

SECTIONAL ELEVATION OF THE GAUGE USED BY J. DICKENSON AND CO., AT APSLEY MILL, HEMEL HEMPSTEAD, HERTS, 1852.



before the Philosophical Society of Manchester, on the 6th Feb., 1844. The paper is published in the 7th vol. of the 2nd series of "The Memoirs of the Literary and Philosophical Society of Manchester."

It is self-evident that such a gauge as Mr. Dickenson's can no more be said to represent the infiltration of rain through chalk than through gravel or peat. Snow falling on such a gauge would be blown away, while the melting of snow gives a large supply of water to the chalk formation. Experience proves that observations must be made over extensive tracts of land of different geological formations, and not upon a surface of soil about the diameter of a good-sized flowerpot, to enable us to ascertain what proportion of the rain sinks into, or flows off, the various kinds of rock.

Mr. Evans states in the same letter, that "by gauges constructed for the purpose of ascertaining the quantity of rain-fall that percolated to the springs, it was found that on an average of 19 years, out of an annual rain-fall of about 26 inches, less than 9 inches descended to a depth of 3 feet below the surface; and that, taking this quantity as percolating to the springs throughout the area of the gathering ground of the river Gade, above Hunton-bridge, it gave, by calculation, a supply of water that coincided as nearly as possible with the actual average flow of the river at that point." I have just shown that Mr. Evans's assertions are to be received with great caution. When all the details upon which this "calculation" is founded are given to the world, I will undertake to test its value. At present I have good reason for disagreeing with this statement.

In further confirmation of the statements made in my paper, the following practical illustrations of the large amount of water that can be derived from the chalk strata, may interest your readers.

Messrs. Dickenson and Evans have five paper mills upon the rivers Gade and Colne. Owing to the large amount of pure water obtained in 1840, by Mr. Paten, from four small bore holes sunk in the chalk strata, at Bushey-meadows, near Watford, by order of the late Marquis of Westminster, then chairman of a Committee of the House of Lords, sitting on the supply of water to the metropolis, Messrs. Dickenson, in 1843, employed Mr. Paten to sink a bore hole for them into the chalk at one of their mills called Home-park Mill. This bore hole is 10 inches diameter at the top, and 6 inches in diameter at the bottom, and 230 feet deep. From this bore hole, since 1843, Messrs. Dickenson have constantly raised more than 450,000 gallons per day.

In 1845, Messrs. Dickenson employed Mr. Paten to put another bore hole at one of their mills, called Apsley Mill. This bore hole is 10 inches diameter, and 205 feet deep. From this bore hole 250,000 gallons of water per day have been raised ever since.

In 1845, Messrs. Dickenson employed Mr. Paten to put in another bore hole at another of their mills, called Nash Mill. This boring is 11 inches diameter at the top, 6 inches diameter at the bottom, and 210 feet deep. From this bore hole 450,000 gallons of water per day have been raised ever since.

In 1848, Messrs. Dickenson again employed Mr. Paten to put in a bore hole at another of their mills, called Batchworth Mill. This bore hole which is 18 inches diameter for 37 feet, 10 inches diameter for 50 feet, and 7½ inches diameter for 220 feet in depth; making a total

of about 307 feet in depth. From this bore hole 500,000 gallons per day have ever since been raised.

Messrs. Dickenson are now, therefore, and have for many years past, been raising more than 1½ million of gallons of water per day, from four small borings sunk in the chalk strata, for the manufacture of paper, the river water not being pure enough for this purpose.

Notwithstanding, that Messrs. Dickenson and Evans have thus turned, and are now turning to their own private advantage, the labours of Mr. Paten, who first practically proved what a large amount of pure spring water can easily be procured from the chalk strata in suitable localities, yet in discussing this subject, Mr Evans never once alluded to the facts I have named.

When we remember, that the Registrar General's returns during the late visitation of cholera, have proved, that the unwholesome water now supplied from the Thames to London, has tended in no small degree to propagate the pestilence, and to hurry thousands of persons to their graves during the last year, I am sure you will feel with me, that the truth, and the whole truth, relating to this subject, cannot be too fully known.

I am, sir,
Your's obediently,
SAMUEL COLLETT HOMERSHAM.
19, Buckingham-street, Adelphi, Feb. 21, 1855.

MEETINGS FOR THE ENSUING WEEK.

MON. Actuaries, 7. Discussion "On the Methods in Use of Valuing Contingent Reversionary Interests."
Geographical, 8½. 1. Letter from Mr. A. R. Wallace, giving "An Account of Singapore and Malacca, as far as Mount Ophir." 2. Dr. T. C. Sutherland, "Meteorological Observations during a Passage from London to Algoa Bay." 3. "Extracts of a Letter from the Rev. Dr. Rebman, dated Kisuludini in Rabbai, S. E. Africa. 4. Mr. T. Maclear, "On the Coast Survey of South Africa." 5. Notice on the Departure of the North Australian Expedition.

TUES. Royal Inst., 3. Professor Tyndall, "On Electricity."
Civil Engineers, 8. Mr. E. E. Allen, "On Steam and Sailing Colliers, and the modes of Ballasting."
Med. and Chirurg., 8½.
Zoological, 9.

WED. Royal Soc. Literature, 4½.
Microscopical, 7. Anniversary.
Society of Arts, 8. Prof. John Wilson, F.R.S.E., "On the Iron Industry of the United States."

THURS. Royal Inst., 3. Mr. Donne, "On English Literature."
Antiquaries, 8.
Photographic, 8.
Royal, 8½.

FRI. Botanical, 8.
Royal Inst., 8½. Dr. J. Stenhouse, "On the Economical Application of Charcoal to Sanitary Purposes."

SAT. Asiatic, 2.
Royal Inst. 3. Dr. Gladstone, "On the Principles of Chemistry."
Medical, 7. Annual Election.

PATENT LAW AMENDMENT ACT, 1852.

APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, Feb. 16th*, 1855.]

Dated 24th October, 1854.
2264. J. Adams, Massachusetts—Printing machinery.
Dated 23rd December, 1854.
2719. W. De la Rue, Bunhill-row—Treating products from naptha.
Dated 30th December, 1854.
2758. F. Preston, Manchester—Bayonets.
Dated 16th January, 1855.
116. J. A. F. V. Oudin, Mons, France—Preventing sea sickness.
Dated 22nd January, 1855.
163. S. Trotman, Portman-square—Filtering apparatus.
Dated 26th January, 1855.
206. J. H. Johnson, 47, Lincoln's-inn-fields—Kites for carrying lines and signalling. (A communication.)
Dated 29th January, 1855.
215. W. Polkinhorn, Gwennap, Redruth—Cleansing wheat.
217. J. D. Humphreys, 20, Charlotte-street, Caledonian-road—Steam engines.
219. G. Goodfellow, Great Fenton, Stoke-upon-Trent—Supplying heated air to ovens, kilns, and steam-engine boilers.
221. T. Binks, Wentworth—Raising and regulating the supply of water.
223. J. H. Johnson, 47, Lincoln's-inn-fields—Generation of steam. (A communication.)
225. E. Death and J. Popplewell, Halstead—Stop valve.
Dated 30th January, 1855.
227. D. Moline, Adelaide-place—Metallic window-frames and sky lights. (A communication.)
228. R. A. Brooman, 166, Fleet-street—Filter. (A communication.)
230. G. W. Henri, York—Meal mixture for cattle.
232. D. Warren, Glasgow—Screw propellers.
Dated 31st January, 1855.
233. J. Smith and J. Hollingworth—Langley Mills—Paper.
235. S. White, Southport—Crayons.
237. J. Howard, Bedford—Ploughs.
239. M. and A. Samuelson, Hull—Steam engines.
241. J. Harrington, 14, Pelham-street, Brompton—Priming fire-arms.
Dated 1st February, 1855.
243. W. Taylor, 16, Oxford-terrace, Hyde-park—Cables.
244. T. O Dixon, Steeton, Keighley—Wood-working machinery.
245. A. Prince, 4, Trafalgar-square—Fire-arms. (A communication.)
246. J. Jecks, Norwich—Machine for sweeping grass.
247. A. W. Williamson, University College—Apparatus for feeding fires.
Dated 2nd February, 1855.
248. B. Goodfellow, Hyde—Ordnance.
250. G. Ritchie, 3, Monmouth-p ace, New Cross—Mattresses.
251. J. Castel and Dr. F. M. Beaupré, Marseilles—Lamp burner.
252. J. Carlhian and J. Corbière, 27, Castle-street, Holborn—Moderator lamps.
Dated 3rd February, 1855.
256. R. J. Mary'on, 37, York-road, Lambeth—Projectiles.
258. E. Clegg and J. Leach, Littleborough—Temples for looms.
260. H. V. P. de la Bertoche, Paris—Paper.
262. E. C. Bisshopp, Stonehouse—Breech-loading fire-arms.
Dated 5th February, 1855.
264. A. E. L. Bellford, 32, Essex-street, Strand—Hulls of vessels. (A communication.)
266. A. Morton, Kilmarnock—Weaving carpets.
268. J. Dorrell, Bilston—Rolling iron.
270. J. Imray, 64, Bridge-road, Lambeth—Measuring instruments.
272. P. J. Carré, Asnières, Seine—Ornamenting fabrics with metal leaf.
Dated 6th February, 1855.
274. D. J. Hoare, 10, Salisbury-street, Strand—Propelling vessels.
276. H. Trappes, Manchester—Preparation of leather for a new flock. (A communication.)
280. J. H. Johnson, 47, Lincoln's-inn-fields—Waterproofing. (A communication.)
282. W. S. Roberts, Lodersville, Susquehanna—Coupling railway carriages.
284. J. Grainger, Birchwood, Alfreton—Pantiles.

WEEKLY LIST OF PATENTS SEALED.

Sealed February 16th, 1855.
1834. Thomas Miller, Fair-field-place, Stepney—Improvements in apparatus for raising coals and other weights from the holds of ships and other places.
1852. James Hadden Young, 66, Great College-street, Camden-town—Improvements in the construction of railways.
1947. Joseph Westwood and Robert Baillie, Poplar—Method of protecting iron ships and vessels from corrosion and animal and vegetable matters.
Sealed February 20th, 1855.
1839. Thomas Lees, Stockport—Improvements in the mode of lubricating parts of steam engines and of apparatus attached to steam boilers, and in the method of preparing and adapting certain substances for that purpose.
1860. Thomas Hayter, King's Head, Southwark—Improvements in apparatus for holding straps for sharpening razors.
1861. Hector Grand de Chateauneuf, Paris—Improvements in the process and apparatus for washing.
1869. William Woodcock, Earl's Court Brewery, Brompton—Improvement in the construction of furnaces.
1890. Louis Napoleon Langlois, and Jean Baptiste Clavières, Paris—Mode of constructing steam boilers.
1892. John Seithen, 13, Wakefield-street, Brunswick-square—Improvements in the manufacture of cases or envelopes for covering bottles.
1903. John Macmillan Dunlop, Manchester—Improvements in machinery or apparatus for preparing, cleaning, and cutting India rubber and gutta percha.
1911. Peter Armand le Comte de Fontaine Moreau, 4, South-street, Finsbury—Improvements in apparatus for retarding and stopping railway carriages.
1928. George Mackay Miller, Inchicore, Dublin—Improvements in axle boxes, and parts working in connection with axles of carriages and other vehicles in use upon railways.
1953. Henry Lund, Temple—Improvements in propelling and steering vessels, and in the steam engine applied to these purposes.
2121. Alfred Vincent Newton, 66, Chancery-lane—Improvements in motive-power engines applicable to the working of their valves and to the conversion of the reciprocating motion of such engines into rotary motion.
2387. Edward Loysel, Rue de Grétry, Paris—Improvements in obtaining infusions or extracts from various substances.
2403. Ismael Isaac Abadie, Paris—Improvements in the mode of working screw-propellers.
2609. Alfred Vincent Newton, 66, Chancery-lane—Improved manufacture of conducting wire for electric telegraphs.